Apprenticeship and Industry Training

Heavy Equipment Technician

Apprenticeship Course Outline

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Course Outline

FIRST PERIOD 12
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Apprenticeship and Industry Training System

Apprenticeship is post-secondary education with a difference. It helps ensure Alberta has a steady supply of highly skilled employees, the foundation of our economy's future health and competitiveness.

Apprentices in more than 50 trades and crafts spend between one and four years learning their trade - 80% of the time on the job under the supervision of a certified journeyman or qualified tradesperson. The balance of the program is technical training in the theory, skills and technologies of their trade.

To become certified journeymen apprentices must learn theory and skills, and they must pass examinations. Requirements for certification—including the content and delivery of technical training—are developed and updated by the Alberta Apprenticeship and Industry Training Board (the Board) and a network of local and provincial industry committees.

The graduate of the Heavy Equipment Technician apprenticeship training is a journeyman who will be able to:

- to diagnose repair, and maintain by skills and knowledge gained through training and experience any of the working parts of diesel engines as well as the various components of mobile industrial equipment.
- to use, competently, both hand and power tools in order to carry out repairs according to manufacturer's specifications.
- to read and understand work orders, prepare estimates, and interpret technical manuals.
- to write service reports, diagnose the cause of failures and keep service analysis records.
- when fully competent in all phases of general repairs, a Heavy Equipment Technician may specialise in any one of several areas of the trade such as, fuel pumps and injectors, track equipment, engine overhaul, hydraulic controls, power shift transmissions and allied equipment.
- outstanding individuals may advance to service representatives or supervisory positions.
- to be familiar with the work in related trades such as Machinist and Welder.

Apprenticeship and Industry Training Committee Structure

While government supports Alberta's apprenticeship and industry training system, it is driven by industry, a term which includes both employers and employees. The Alberta Apprenticeship and Industry Training Board, with the support of Alberta Advanced Education, oversees the system. But the system relies on a network of industry committees. These committees include local and provincial apprenticeship committees (LACs and PACs) in the designated trades and occupational committees (OCs) in the designated occupations, as well as other committees such as provisional committees established before the designation of a new trade or occupation comes into effect. All these committees are composed of equal numbers of employers and employees. The network of industry committees is the foundation of Alberta's apprenticeship and industry training system.

Local Apprenticeship Committees (LAC)

Wherever there is activity in a trade, the Board can set up a LAC. The Board appoints equal numbers of employees and employers for terms of up to three years. The committee appoints a member as presiding officer. Local Apprenticeship Committees:

- monitor the apprenticeship system, and the progress of apprentices in their trade, at the local level.
- help settle certain kinds of issues between apprentices and their employers.
- recommend improvements in apprenticeship training and certification to their trade's provincial apprenticeship committee.
- make recommendations to the Board regarding the appointment of members to their trade's PAC.

Provincial Apprenticeship Committees (PAC)

The Board establishes a PAC for each trade and, based on PAC recommendations, appoints a presiding officer and equal numbers of employees and employers for terms of up to three years. Most PACs have nine members. Provincial Apprenticeship Committees:

- identify the training needs and content for their trade.
- recommend to the Board the standards for training and certification for their trade.
- monitor the activities of local apprenticeship committees in their trade.
- make recommendations to the Board about the designation of trades and occupations.
- determine whether training of various kinds is equivalent to training provided in an apprenticeship program in the trade.
- may participate in resolving any apprenticeship-related disputes between employers and employees.

Heavy Equipment Technician PAC Members

Mr. M. Larson	Edmonton	Presiding Officer
Mr. D. Harris	High Level	Employer
Mr. D. Scott	Red Deer	Employer
Mr. D. Mitty	Sherwood Park	Employer
Mr. A. Meurs	Grande Prairie	Employer
Mr. R. Cosen	Calgary	Employer
Mr. P. Valgardson	Taber	Employee
Mr. A. Paananen	Fort McMurray	Employee
Mr. J. Dawson	Edmonton	Employee
Mr. D. Hardes	Lloydminster	Employee
Mr. M. Allen	Calgary	Employee

The Alberta Apprenticeship and Industry Training Board (Board)

The mandate of the Alberta Apprenticeship and Industry Training Board relates to the standards and requirements for training and certification in programs under the *Apprenticeship and Industry Training Act*. The Board provides advice to the Minister of Advanced Education on the training and certification of people in designated trades and occupations and on the needs of the Alberta labour market for skilled and trained persons. The Board also makes orders and regulations respecting standards and requirements for apprenticeship programs and the training of apprentices and for training and certification in designated trades and occupations, and the criteria or requirements for granting and recognizing trade and other certificates.

The 13-member Board consists of a chair, eight members representing trades and four members representing other industries. Employer and employee representatives equally represent the trades and other industry members.

Safety Education

Safe working procedures and conditions, accident prevention and the preservation of health are of primary importance in apprenticeship programs in Alberta. These responsibilities are shared and require the joint efforts of government, employers, employees and the public. Therefore, it is imperative that all parties become aware of circumstances that may lead to injury or harm. Safe learning experiences and environments can be created by controlling the variables and behaviours that may contribute to or cause an accident or injury.

It is generally recognized that a safe attitude contributes to an accident free environment. Everyone will benefit as a result of a healthy, safe attitude towards prevention of accidents.

A tradesperson is possibly exposed to more hazards than any other person in the work force and, therefore, should be familiar with and apply the Occupational Health and Safety Act and Regulations dealing with personal safety and the special safety rules applying to each task.

Legal and Administrative Aspects of Safety

Accident prevention and the provisions of safe working conditions are the responsibilities of an employer and employee.

Employer's Responsibilities

The employer is responsible for:

- providing and maintaining safety equipment and protective devices.
- ensuring proper safe work clothing is worn.
- enforcing safe working procedures.
- providing safeguards for machinery, equipment and tools.
- observing all accident prevention regulations.
- training employees in the safe use and operation of equipment.

Employee's Responsibilities

The employee is responsible for:

- working in accordance with the safety regulations pertaining to the job environment.
- working in such a way as not to endanger themselves or fellow employees.

Occupational Health and Safety's Responsibilities:

Occupational Health and Safety (Alberta Human Resources and Employment) will conduct periodic inspections of the workplace to ensure that safety regulations for industry are being observed.

Technical Training Establishment

Alberta Advanced Education, Apprenticeship and Industry Training offer your apprenticeship training program. Staff and facilities for delivering the program are supplied by:

- Northern Alberta Institute of Technology
- Southern Alberta Institute of Technology
- Keyano College
- Lakeland College
- Lethbridge Community College
- Northern Alberta Institute of Technology – Fairview
- Olds College
- Red Deer College

Procedures For Recommending
Revisions To The Course Outline

Apprenticeship and Industry Training, Industry Programs and Standards has prepared this course outline in partnership with the Heavy Equipment Technician Provincial Apprenticeship Committee.

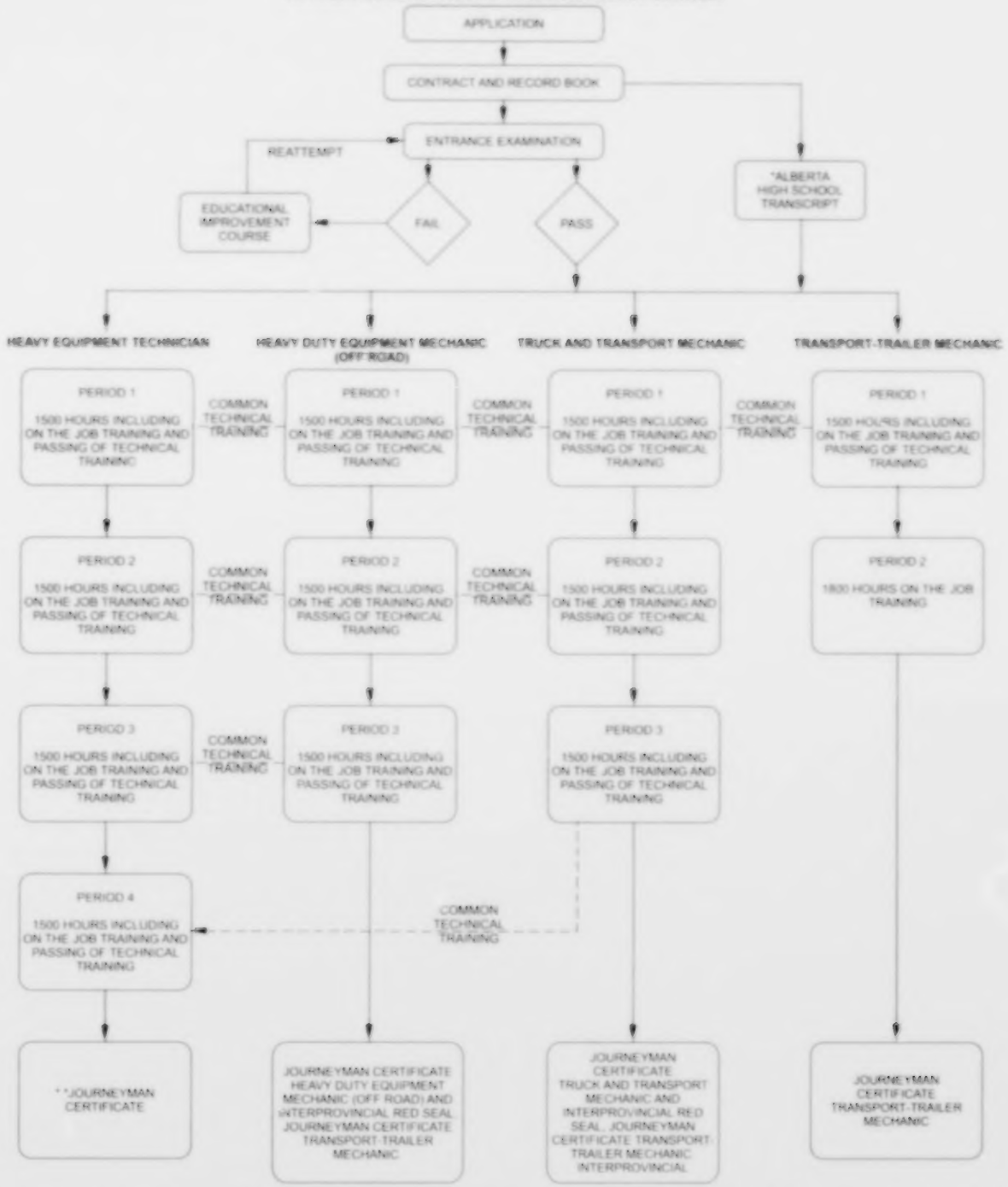
This course outline was approved on March 20, 2006 under the authority of the Alberta Apprenticeship and Industry Training Board on a recommendation from the Provincial Apprenticeship Committee. Valuable input is acknowledged from industry and the institutions.

Any concerned citizen or group in the Province of Alberta may make recommendations for change by writing to:

Heavy Equipment Technician Provincial Apprenticeship Committee
c/o Industry Programs and Standards
Apprenticeship and Industry Training
10th floor, Commerce Place
10155 - 102 Street
Edmonton, AB T5J 4L5

It is requested that recommendations for change refer to specific areas and state references used. Recommendations received will be placed before regular meetings of the Provincial Apprenticeship Committee.

APPRENTICESHIP ROUTE TOWARDS CERTIFICATION


APPLICATION
CONTRACT AND RECORD BOOK
ENTRANCE EXAMINATION
REATTEMPT
EDUCATIONAL IMPROVEMENT COURSE
FAIL
PASS
*ALBERTA HIGH SCHOOL TRANSCRIPT
HEAVY EQUIPMENT TECHNICIAN
HEAVY DUTY EQUIPMENT MECHANIC (OFF ROAD)
TRUCK AND TRANSPORT MECHANIC
TRANSPORT-TRAILER MECHANIC
PERIOD 1
1500 HOURS INCLUDING ON THE JOB TRAINING AND PASSING OF TECHNICAL TRAINING
COMMON TECHNICAL TRAINING
PERIOD 2
1500 HOURS INCLUDING ON THE JOB TRAINING AND PASSING OF TECHNICAL TRAINING
1800 HOURS ON THE JOB TRAINING
PERIOD 3
1500 HOURS INCLUDING ON THE JOB TRAINING AND PASSING OF TECHNICAL TRAINING
PERIOD 4
1500 HOURS INCLUDING ON THE JOB TRAINING AND PASSING OF TECHNICAL TRAINING
* *JOURNEYMAN CERTIFICATE
JOURNEYMAN CERTIFICATE HEAVY DUTY EQUIPMENT MECHANIC (OFF ROAD) AND INTERPROVINCIAL RED SEAL JOURNEYMAN CERTIFICATE TRANSPORT-TRAILER MECHANIC
JOURNEYMAN CERTIFICATE TRUCK AND TRANSPORT MECHANIC AND INTERPROVINCIAL RED SEAL, JOURNEYMAN CERTIFICATE TRANSPORT-TRAILER MECHANIC INTERPROVINCIAL
JOURNEYMAN CERTIFICATE TRANSPORT-TRAILER MECHANIC

*ALBERTA HIGH SCHOOL TRANSCRIPT WITH A PASS MARK IN MATH 20 OR 23, APPLIED MATH 20 OR PURE MATH 20; AND ENGLISH 20 OR 23; AND SCIENCE 20, PHYSICS 20, BIOLOGY 20 OR CHEMISTRY 20

** A PERSON HOLDING A "JOURNEYMAN HEAVY EQUIPMENT TECHNICIAN" CERTIFICATE WILL RECEIVE THE TRANSPORT-TRAILER MECHANIC, TRUCK AND TRANSPORT MECHANIC, AND THE HEAVY DUTY EQUIPMENT MECHANIC (OFF ROAD) CERTIFICATES. CANDIDATES ARE ALSO ELIGIBLE TO RECEIVE THE INTERPROVINCIAL RED SEAL FOR TRUCK AND TRANSPORT MECHANIC AND THE HEAVY DUTY EQUIPMENT MECHANIC (OFF ROAD)

Heavy Equipment Technician Training Profile
FIRST PERIOD
(8 Weeks 30 Hours per Week – Total of 240 Hours)

SECTION ONE

SAFETY, MATERIALS AND TOOLS
40 Hours

A	B	C
Safety And Communications 5 Hours	Lifting Procedures And Wire Rope 8 Hours	Materials And Fastening Devices 4 Hours
D	**E**	**F**
Hand, Shop And Power Tools 6 Hours	Measuring Tools 8 Hours	Oxy-Fuel, Equipment, Heating and Cutting 9 Hours

SECTION TWO

SUSPENSIONS, WHEELS AND, SYSTEMS
53 Hours

A	B	C
Frame And Suspension Fundamentals 7 Hours	Frame And Suspension Service 9 Hours	Bearings And Seals 6 Hours
D	**E**	**F**
Wheels, Tires, And Hubs 9 Hours	Trailer Systems And Components 3 Hours	Coupling Units And Landing Gear Fundamentals And Service 9 Hours
G	**H**	
Orientation to Trailer Inspection 4 Hours	Preventive Maintenance 6 Hours	

SECTION THREE

HYDRAULIC BRAKE SYSTEMS
33 Hours

A	B	C
Hydraulic Brake System Fundamentals 3 Hours	Hydraulic Brake System (Drum And Disc) 7 Hours	Hydraulic Brake System Diagnosis And Service 7 Hours
D	**E**	**F**
Hydraulic Brake Booster System Fundamentals And Service 11 Hours	Parking Brake System Fundamentals And Service 3 Hours	Electric Brake Fundamentals And Service 2 Hours

SECTION FOUR

ELECTRICAL I & ELECTRONICS I
48 Hours

A	B	C
Electrical Theory 4 Hours	Electrical Circuits 7 Hours	Magnetism 5 Hours
D	**E**	**F**
Test Equipment 4 Hours	Battery Fundamentals And Service 7 Hours	Electrical Wiring, Lighting Circuits And Circuit Protection 9 Hours
G	**H**	
Basic Electronics 6 Hours	Electronic Control Systems 6 Hours	

SECTION FIVE

HYDRAULICS I

21 Hours

⇨

A	B	C
Hydraulic Fundamentals 9 Hours	Hydraulic System Components: Reservoir, Filters, Hoses And Coolers 6 Hours	Hydraulic System Components: Pumps, Valves, Cylinders And Accumulators 6 Hours

SECTION SIX

AIR BRAKES

45 Hours

⇨

A	B	C
Air Brake System Fundamentals 4 Hours	Air Brake System Mechanical Components 6 Hours	Truck/Tractor Air Brake System Components 12 Hours
D	**E**	**F**
Trailer Air Brake System Components 8 Hours	Air Brake Testing And Service 9 Hours	Air Antilock Brake System Fundamentals 6 Hours

SECOND PERIOD
(8 Weeks 30 Hours per Week – Total of 240 Hours)

SECTION ONE

ENGINE FUNDAMENTALS, SERVICE AND REPAIR
75 Hours

A	B	C
Engine Fundamentals 6 Hours	Engine Block And Cylinder Liner Fundamentals 6 Hours	Engine Block And Cylinder Liner Service 6 Hours
D	**E**	**F**
Piston, Piston Rings And Connecting Rod Fundamentals 6 Hours	Piston, Piston Rings And Connecting Rod Service 6 Hours	Crankshaft, Bearings And Related Component Fundamentals 6 Hours
G	**H**	**I**
Crankshaft, Bearings And Related Component Service 6 Hours	Camshaft And Follower Fundamentals 6 Hours	Camshaft And Follower Service 6 Hours
J	**K**	**L**
Cylinder Head Fundamentals 9 Hours	Cylinder Head Service 9 Hours	Engine Braking System Fundamentals And Service 3 Hours

SECTION TWO

ENGINE SYSTEMS
30 Hours

A	B	C
Air Induction And Exhaust Systems 6 Hours	Turbo Charged Air Systems 6 Hours	Lubrication Systems And Crankcase Ventilation 9 Hours
D		
Cooling Systems (Liquid And Air) 9 Hours		

SECTION THREE

DIESEL FUEL INJECTION SYSTEMS
40 Hours

A	B	C
Diesel Fuel And Storage Tanks (Machine And Bulk Storage) 3 Hours	Combustion Process And Starting Aids 4 Hours	Basic Fuel Injection System 3 Hours
D	**E**	**F**
Fuel System Service 5 Hours	Port/Helix Metering Fuel Systems 6 Hours	Opposed Plunger Inlet Fuel Metering Systems 6 Hours
G	**H**	**I**
Diesel Fuel Injector Fundamentals And Service 6 Hours	Engine Governor Fundamentals And Service 6 Hours	Emergency Shut-down Systems 1 Hour

SECTION FOUR

ELECTRONICS FUEL MANAGEMENT
45 Hours

A	B	C
Electronic Fuel System Fundamentals 15 Hours	Electronic Controlled Fuel Injection Systems 12 Hours	Performance Analysis And Tune-up 18 Hours

SECTION FIVE

HEAVY DUTY CHARGING & CRANKING SYSTEMS

50 Hours

A
Charging System And Control Circuit Fundamentals
12 Hours

B
Charging System Testing And Service
18 Hours

C
Cranking System Fundamentals And Motor Drives
3 Hours

D
Cranking System Control Circuits
3 Hours

E
Cranking System Testing And Service
12 Hours

F
Non-Electric Cranking Systems
2 Hours

THIRD PERIOD
(8 Weeks 30 Hours per Week – Total of 240 Hours)

SECTION ONE

HYDRAULICS II
114 Hours

A	B	C
Hydraulic Principles 9 Hours	Hydraulic Pump Fundamentals 9 Hours	Hydraulic Pump Service 12 Hours
D	**E**	**F**
Hydraulic Actuator Fundamentals 6 Hours	Hydraulic Actuator Service 9 Hours	Hydraulic Valve II 18 Hours
G	**H**	**I**
Hydraulic System Types 18 Hours	Hydraulic System Testing And Service 18 Hours	Electro-Hydraulics 15 Hours

SECTION TWO

STEERING AND SUSPENSION SYSTEMS & ACCESSORIES (SPECIFIC TO OFF ROAD)
34 Hours

A	B	C
Wheeled Equipment Steering Fundamentals And Service 10 Hours	Suspension System Fundamentals And Service 6 Hours	Off-Road Equipment Accessories And Attachments 6 Hours
D	**E**	
Off-road Electrical Circuit Fundamentals 6 Hours	Off-road Electrical Circuit Service 6 Hours	

SECTION THREE

POWER TRAIN (SPECIFIC TO OFF ROAD)
92 Hours

A	B	C
Gearing Principles 3 Hours	Torque Converter Fundamentals And Service 9 Hours	Powershift And Automatic Transmission Mechanical/Electronic Components 14 Hours
D	**E**	**F**
Powershift And Automatic Transmission Control And Shifting 10 Hours	Hydraulic Retarder Fundamentals 3 Hours	Powershift And Automatic Transmission Testing And Service 10 Hours
G	**H**	**I**
Tracked Equipment Steering Fundamentals And Service 11 Hours	Undercarriage Systems Fundamentals And Service 11 Hours	Final Drive Fundamentals And Service (off road) 6 Hours
J	**K**	
Drive Axle and Differential Fundamentals & Service (off road) 12 Hours	Clutch Fundamentals and Service 3 Hours	

FOURTH PERIOD
(8 Weeks 30 Hours per Week – Total of 240 Hours)

SECTION ONE

POWER TRAIN (SPECIFIC TO TRUCK AND TRANSPORT)
124 Hours

A	B	C
Clutch Fundamentals And Service 9 Hours	Drive Line Fundamentals And Service 12 Hours	Gearing Principles 3 Hours
D	**E**	**F**
Transmission Fundamentals 12 Hours	Transmission Shifting 12 Hours	Transmission Service 30 Hours
G	**H**	**I**
Transfer Case and Auxiliary Drives 4 Hours	Drive Axle Assembly Fundamentals (on road) 12 Hours	Drive Axle Assembly Service (on road) 30 Hours

SECTION TWO

STEERING SYSTEMS
27 Hours

A	B	C
Steering Fundamentals 8 Hours	Steering Service 10 Hours	Steering Angles And Alignment 9 Hours

SECTION THREE

AIR CONDITIONING
36 Hours

A	B	C
Air Conditioning Fundamentals 8 Hours	HVAC Control Systems (Heating, Ventilation And A/C) 12 Hours	Air Conditioning Testing And Service 16 Hours

SECTION FOUR

ANTI LOCK BRAKE SYSTEMS (AIR AND HYDRAULIC BRAKES)
26 Hours

A	B	C
Air Anti Lock Brake Systems 6 Hours	Air Anti Lock Brake System Diagnosis 10 Hours	Hydraulic Anti Lock Brake Systems 10 Hours

SECTION FIVE

VEHICLE ELECTRICAL DIAGNOSIS & FAILURE ANALYSIS
27 Hours

A	B	C
Truck Electrical Circuit Fundamentals 6 Hours	Truck Electrical Circuit Service 7 Hours	Failure and Fluid Analysis 8 Hours
D		
Orientation to Vehicle Inspection 6 Hours		

NOTE: The hours stated are for guidance and should be adhered to as closely as possible. However, adjustments must be made for rate of apprentice learning, statutory holidays, registration and examinations for the training establishment and Apprenticeship and Industry Training.

FIRST PERIOD TECHNICAL TRAINING
HEAVY EQUIPMENT TECHNICIAN TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

SECTION ONE: ..... SAFETY, MATERIALS AND TOOLS..... 40 HOURS

A. Safety And Communications ..... 5 Hours

Outcome: ***Demonstrate communication skills and workshop safety as it pertains to Occupational Health and Safety standards.***

1. Communicate trade-related information using standard terms for components and operations.
2. Identify key areas of responsibility that an employee has in regards to shop and trade safety.
3. Explain correct use of fire extinguishers.

B. Lifting Procedures and Wire Rope ..... 8 Hours

Outcome: ***Perform lifting operations using proper techniques and equipment as it pertains to Occupational Health and Safety standards.***

1. Describe manual lifting operations using correct body mechanics.
2. Describe lifting equipment, grading, sizing and limits.
3. Select equipment for rigging typical loads.
4. Describe applications of wire rope on machinery following regulations set out by Occupational Health and Safety Act.
5. Demonstrate the correct use of jacking and blocking techniques common to off-road and on road equipment and, trailers.

C. Materials And Fastening Devices ..... 4 Hours

Outcome: ***Identify materials and fasteners commonly used in the trade.***

1. Identify common metallic materials and their applications.
2. Identify common non-metallic materials and their applications.
3. Identify types of threaded fasteners and their applications.
4. Explain the torque procedures and precautions required when securing fastening devices.
5. Identify types of non-threaded fasteners and their applications.

D. Hand, Shop And Power Tools ..... 6 Hours

Outcome: Demonstrate the correct use of hand, shop and power tools common to the trade.

1. Describe types, uses and care of hand tools.
2. Describe the procedures required to safely operate various types and capacities of shop puller and pressing equipment.
3. Describe and use cutting hand tools common to the trade.
4. Demonstrate proper care and safe use of common power hand tools.

E. Measuring Tools ..... 8 Hours

Outcome: Demonstrate the correct use of measuring tools common to the trade.

1. Perform calculations related to measurement using imperial and metric units.
2. Perform linear measurements using basic measuring tools.
3. Perform linear measurements using precision measuring tools.
4. Perform accurate torque measurements using torquing tools.

F. Oxy-Fuel, Equipment, Heating and Cutting ..... 9 Hours

Outcome: Perform metal cutting and heating operations safely using oxyacetylene equipment.

1. Describe the characteristics and handling procedures for oxygen, propane and acetylene.
2. Demonstrate handling procedures for regulators and hoses.
3. Demonstrate the use, care, and maintenance of torches and tips.
4. Demonstrate the use of personal protective equipment.
5. Perform heating and cutting operations using oxygen and acetylene.

SECTION TWO: ..... SUSPENSIONS, WHEELS AND, SYSTEMS ..... 53 HOURS

A. Frame And Suspension Fundamentals ..... 7 Hours

Outcome: Explain the operating principles and design features of common frame and suspension systems.

1. State the functions of a vehicle frame.
2. Identify types, designs and components of frames commonly used in truck and trailer applications.
3. State the functions of a vehicle suspension system.
4. Explain the operating principles of common suspension systems.

B. Frame And Suspension Service ..... 9 Hours

Outcome: Repair common types of frame and suspension systems.

1. Explain frame inspection and repair procedures.

2. Explain the causes of suspension system malfunction.
3. Explain suspension system repair procedures.

C. Bearings And Seals ..... 6 Hours

Outcome: Service common bearings and seals.

1. State bearing functions and applications.
2. State seal functions and applications.
3. Diagnose common bearing and seal faults.
4. Perform bearing and seal service.

D. Wheels, Tires, And Hubs ..... 9 Hours

Outcome: Service wheels, tires and hubs.

1. Identify common wheel types and mounting designs.
2. Explain tire construction, care and maintenance in relation to design.
3. State the safety procedures required when handling wheels and tires.
4. Perform wheel removal, inspection and installation.
5. Explain wheel balancing.
6. Diagnose wheel and tire faults.

E. Trailer Systems And Components ..... 3 Hours

Outcome: Identify common trailer systems and components.

1. Describe types and configurations of on highway trailers.
2. Identify trailer configurations according to number of axles and hitch points.
3. Identify trailer axle configurations; fixed and steering.

F. Coupling Units And Landing Gear Fundamentals And Service ..... 9 Hours

Outcome: Service trailer coupling systems and landing gear.

1. Identify common types of trailer coupling units.
2. Service a fifth wheel assembly.
3. Service a no-slack pintle hitch.
4. Identify common types of trailer landing gear.
5. Service common types of trailer landing gear.
6. Explain procedures and safety precautions required when coupling and uncoupling trailer systems.

G. Orientation To Trailer Inspection ..... 4 Hours

Outcome: Explain trailer inspection according to CVI regulations.

1. Outline trailer inspection regulations.
2. Identify conditions caused by damage, wear or corrosion, which would make a trailer unsafe or inoperable.

H. Preventive Maintenance ..... 6 Hours

Outcome: Explain typical maintenance programs used with off-road and on road equipment.

1. Explain the types of maintenance systems.
2. Explain the principles of preventive maintenance.
3. Explain the principles of predictive maintenance.
4. Demonstrate basic preventive maintenance and service procedures.

SECTION THREE: .....HYDRAULIC BRAKE SYSTEMS..... 33 HOURS

A. Hydraulic Brake System Fundamentals ..... 3 Hours

Outcome: Apply scientific principles to braking system operation.

1. Explain braking principles with emphasis on heat, friction and hydraulic forces.
2. Explain brake fluids with regards to properties and handling procedures.

B. Hydraulic Brake System (Drum And Disc) ..... 7 Hours

Outcome: Explain the operation of hydraulic drum and disc brake systems.

1. Explain the principles of operation of drum brake systems.
2. Explain the principles of operation of disc brake systems.
3. Explain the construction and operation of master cylinders.
4. Explain the purpose and construction of brake lines and hoses.
5. Explain the construction and operation of wheel cylinders and calipers.
6. Explain the purpose and operation of the metering, proportioning and pressure differential valves.

C. Hydraulic Brake System Diagnosis And Service ..... 7 Hours

Outcome: Service hydraulic drum and disc brake systems.

1. List safety responsibilities required when servicing and repairing brake systems.
2. Diagnose brake system faults.
3. Service a typical drum brake assembly.
4. Service a typical disc brake assembly.

5. Describe reconditioning procedures required for master cylinders, wheel cylinders and brake calipers.
6. Demonstrate brake flushing and bleeding procedures on hydraulic brake systems.

D. Hydraulic Brake Booster System Fundamentals And Service ..... 11 Hours

Outcome: Explain power braking systems service procedures.

1. Identify common power assist braking systems.
2. Explain the principles of operation for vacuum brake booster systems.
3. Describe the diagnosis and repair procedures for vacuum brake booster systems.
4. Explain the principles of operation for air-over-hydraulic brake booster systems.
5. Describe the diagnosis and repair procedures for air-over-hydraulic brake booster systems.
6. Explain the principles of operation for hydraulic-over-hydraulic brake booster systems.
7. Describe the diagnosis and repair procedures for hydraulic-over-hydraulic brake booster systems.

E. Parking Brake System Fundamentals And Service ..... 3 Hours

Outcome: Explain service procedures of parking brake systems.

1. Explain the principles of operation for common parking brake systems.
2. Describe the adjusting procedures for common parking brake systems.
3. Describe repair procedures for common parking brake systems.

F. Electric Brake Fundamentals And Service ..... 2 Hours

Outcome: Explain service procedures of electric braking systems.

1. Explain the principles of operation for electric braking systems.
2. Identify basic electric braking system failures.

SECTION FOUR: ..... ELECTRICAL I & ELECTRONIC I ..... 48 HOURS

A. Electrical Theory ..... 4 Hours

Outcome: Apply scientific principles to explain electrical theory.

1. Explain the physical properties of conductors, semi-conductors and insulators.
2. Explain electricity in terms of voltage, current and resistance.
3. Explain direct current, alternating current and static electricity.

B. Electrical Circuits ..... 7 Hours

Outcome: Identify electrical circuit types and circuit defects.

1. List the components of a basic electrical circuit.
2. Explain the effects of circuit defects on circuit operation.

3. Identify the three circuit types and their properties.
4. Explain electrical laws and formulas that apply to the operation of electrical circuits.
5. Apply electrical laws and formulas to mathematically calculate circuit values.

C. Magnetism ..... 5 Hours

Outcome: Apply scientific principles to explain the theory of magnetism.

1. Explain the fundamental laws of magnetism.
2. Explain the properties and applications of permanent magnets.
3. Explain the construction, operation and application of electromagnets.
4. Explain the principles of electromagnetic induction.

D. Test Equipment ..... 4 Hours

Outcome: Use electrical test equipment to measure electrical values and check circuit operation.

1. Explain the construction and operation of voltmeters, ammeters and ohmmeters.
2. Explain meter precautions when measuring voltage, current and resistance.
3. Measure voltage at various points on a circuit and interpret the results.
4. Measure current flow at various points on a circuit and interpret the results.
5. Measure resistance using an ohmmeter.

E. Battery Fundamentals And Service ..... 7 Hours

Outcome: Service, test and charge a lead-acid battery.

1. Identify hazards encountered with lead-acid storage batteries.
2. Explain battery construction, sizing and capacity.
3. Perform battery maintenance and testing.
4. List safety precautions and procedures for boosting batteries.
5. List the safety precautions and procedures for charging batteries.
6. Explain multiple battery circuits in relation to connections and battery compatibility.

F. Electrical Wiring, Lighting Circuits And Circuit Protection ..... 9 Hours

Outcome: Test and repair electrical circuits.

1. Trace electrical circuits using symbols that are common to the industry.
2. Perform wiring harness inspection and repair.
3. Identify and repair wiring harness connectors that are common to the industry.
4. Test circuit protection devices, switches, relays and solenoids.
5. Repair an electrical lighting circuit for a short circuit, ground fault, open circuit and high resistance.

G. Basic Electronics ..... 6 Hours

Outcome: Test discrete electronic components used in the trade.

1. Compare and contrast solid state electronic and electrical circuitry.
2. Explain the properties, applications and test procedures for resistors.
3. Explain the properties, applications and test procedures for diodes.
4. Identify the conditions that affect the life of electronic devices.

H. Electronic Control Systems ..... 6 Hours

Outcome: Describe the operation of basic computer-controlled systems.

1. Identify the terminology commonly used with computer controls and components.
2. Explain the function of electronic control system components.
3. Explain the interaction between inputs, processors and outputs to control a circuit or a system.
4. Identify electronic test equipment used for diagnosis of electronic systems.

SECTION FIVE: ..... HYDRAULICS I ..... 21 HOURS

A. Hydraulic Fundamentals ..... 9 Hours

Outcome: Explain hydraulic principles.

1. Define hydraulic terminology.
2. Using mathematical calculations, explain the hydraulic principles of pressure, force, area, volume, flow rate, cycle times and power.
3. Draw and interpret basic hydraulic schematics.
4. State the safety precautions that must be observed when working with hydraulic systems.

B. Hydraulic System Components: Reservoir, Filters, Hoses And Coolers ..... 6 Hours

Outcome: Explain the function of the following hydraulic system components; hydraulic oils, reservoirs, filters, conductors, and heat exchangers.

1. Explain the properties of hydraulic fluid and the criteria for its selection.
2. State the functions of the hydraulic reservoir and its related components.
3. State the functions and principles of operation of filtration devices.
4. Explain the construction and applications of common types of hydraulic conductors.
5. State the functions and applications of hydraulic heat exchangers.

C. Hydraulic System Components: Pumps, Valves, Cylinders And Accumulators ..... 6 Hours

Outcome: Explain the functions and principles of operation of hydraulic system components.

1. Explain gear pump operating principles.

2. State the function and principles of operation for a direct acting pressure relief valve.
3. Explain the principles of operation and applications of hydraulic control valves.
4. Explain the principles of operation and applications of basic hydraulic cylinders.
5. Explain the principles of operation and applications of basic hydraulic accumulators.

SECTION SIX: ..... AIR BRAKES ..... 45 HOURS

A. Air Brake System Fundamentals ..... 4 Hours

Outcome: Explain the fundamental principles of operation of an air brake system.

1. Explain the principles of operation of an air brake system.
2. Develop a simple air brake system consisting of a compressor, reservoir, brake valve, steer axle and single drive axle brake chambers, and connecting lines.

B. Air Brake System Mechanical Components ..... 6 Hours

Outcome: Explain the operating principles of air brake mechanical components.

1. Explain the operating principles of a typical cam-operated foundation brake.
2. Explain the operating principles of a typical air disc foundation brake.

C. Truck/Tractor Air Brake System Components ..... 12 Hours

Outcome: Explain the principles of operation of truck/tractor air brake systems.

1. Explain the functions and principles of operation of common air brake supply circuit components.
2. Explain the functions and principles of operation of common primary service brake circuit components.
3. Explain the functions and principles of operation of common secondary service brake circuit components.
4. Explain the functions and principles of operation of common parking/emergency brake circuit components.
5. Explain the functions and principles of operation of common trailer control circuit components.

D. Trailer Air Brake System Components ..... 8 Hours

Outcome: Explain the principles of trailer brake system component operation.

1. Explain the functions and principles of operation of pre-CMVSS 121 single trailer brake circuit components.
2. Explain the functions and principles of operation of CMVSS 121 single trailer brake circuit components.
3. Explain functions and principles of operation of common components used on multiple trailer combinations.

E. Air Brake System Testing And Service ..... 9 Hours

Outcome: Service and diagnose truck/tractor and trailer air brake systems.

1. State the safety precautions that must be observed prior to performing air brake system testing and service.
2. Perform a visual inspection of the air brake system.

3. Perform air brake system testing.
4. Analyse test results and state possible causes for system malfunction.
5. Service cam-operated foundation brakes.

F. Air Antilock Brake System Fundamentals ..... **6 Hours**

Outcome: ***Describe the basic operation of an air antilock brake system.***

1. List the advantages of operating a vehicle equipped with an antilock brake system.
2. Explain the operation of an antilock air brake system.
3. Identify typical system layout and component locations on a vehicle equipped with an antilock air brake system.
4. Describe antilock air brake system service precautions.

SECOND PERIOD TECHNICAL TRAINING
HEAVY EQUIPMENT TECHNICIAN TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

SECTION ONE: ..... ENGINE FUNDAMENTALS, SERVICE AND REPAIR ..... 75 HOURS

A. Engine Fundamentals ..... 6 Hours

Outcome: Explain the operating principles and design features of two and four stroke internal combustion engines.

1. Explain the stages of development of the internal combustion engine.
2. Explain common engine terms and definitions.
3. Explain common methods of classifying engines.
4. Explain the principles of operation for two and four stroke cycle engines.
5. Compare diesel and gasoline engine operation.

B. Engine Block And Cylinder Liner Fundamentals ..... 6 Hours

Outcome: Describe the functions and design features of cylinder block assemblies.

1. State the functions of the engine cylinder block.
2. Identify cylinder block construction and design features.
3. Describe the construction and design features of removable cylinder liners.

C. Engine Block and Cylinder Liner Service ..... 6 Hours

Outcome: Inspect an engine block assembly for serviceability.

1. Inspect engine block for cracks, thread, bearing bore and machined surface condition.
2. Explain cylinder block repair procedures for cracks, threads, bearing bores and machined surfaces.
3. Explain inspection and reconditioning procedures for a cylinder block with integral cylinders.
4. Perform removable cylinder liner service.

D. Piston, Piston Rings And Connecting Rod Fundamentals ..... 6 Hours

Outcome: Describe the functions and design features of pistons, piston rings and connecting rods.

1. Explain the function, construction and design features of pistons and piston pins.
2. Explain the function, construction and design features of piston rings.
3. Explain the function, construction and design features of connecting rods.

E. Piston, Piston Rings and Connecting Rod Service ..... 6 Hours

Outcome: Service a piston and connecting rod assembly.

1. Remove and disassemble piston and connecting rod assemblies.
2. Inspect piston and pin for reuse.
3. Explain connecting rod service procedures.
4. Install piston and connecting rod assemblies.

F. Crankshaft, Bearings and Related Component Fundamentals ..... 6 Hours

Outcome: Describe the functions and design features of crankshafts and their related components.

1. Explain the function and design features of crankshafts.
2. Explain methods used to achieve engine balance.
3. State the functions of crankshaft seals, gears and flywheels.
4. Describe the function and design features of friction bearings specific to engines.
5. Explain the lubrication principles of engine friction bearings.

G. Crankshaft, Bearings and Related Component Service ..... 6 Hours

Outcome: Service crankshafts, friction bearings and related components.

1. Remove crankshaft and bearings from an engine block.
2. Inspect and measure crankshafts to determine serviceability.
3. Inspect flywheel and vibration damper to determine serviceability.
4. Identify common crankshaft and bearing failures.
5. Install crankshafts and related components.

H. Camshaft And Follower Fundamentals ..... 6 Hours

Outcome: Describe the functions and design features of camshafts and related components.

1. Explain the function and design features of camshafts, camshaft bearings and seals.
2. Explain the function and design features of camshaft followers.
3. Explain camshaft drive mechanisms and timing.

I. Camshaft and Follower Service ..... 6 Hours

Outcome: Service camshaft and related components.

1. Remove camshaft and related components from an engine block.
2. Inspect and measure camshafts and related components to determine serviceability.
3. Install camshaft and related components.

J. Cylinder Head Fundamentals ..... 9 Hours

Outcome: Describe the functions and design features of cylinder heads and valve train components.

1. Explain the function, construction and design features of cylinder heads.
2. Describe the construction and design features of engine valves and related components.
3. Describe the construction and design features of valve train components.
4. Identify cylinder head sealing and retention devices.

K. Cylinder Head Service ..... 9 Hours

Outcome: Service cylinder heads and valve train components.

1. Demonstrate cylinder head removal and disassembly.
2. Clean and inspect cylinder heads.
3. Explain cylinder head and valve reconditioning procedures.
4. Inspect valve train components.
5. Demonstrate cylinder head assembly and installation.

L. Engine Braking System Fundamentals and Service ..... 3 Hours

Outcome: Explain the operation of engine compression and exhaust brakes.

1. State the function of an engine brake.
2. Explain the operation of an engine compression brake.
3. Explain basic adjustment and diagnosis of an engine compression brake.
4. Explain the functions and operation of an engine exhaust brake.

SECTION TWO: ..... ENGINE SYSTEMS ..... 30 HOURS

A. Air Induction and Exhaust Systems ..... 6 Hours

Outcome: Service air induction, exhaust systems and related components.

1. State the functions of an air induction system.
2. Identify and state the function of air induction system components.
3. State the function of an exhaust system.
4. Identify and explain the operation of exhaust system components.
5. Explain the service procedures for air induction and exhaust systems.
6. Explain the use of test equipment to measure air inlet restriction and exhaust backpressure.

B. Turbo Charged Air Systems ..... 6 Hours

Outcome: Service turbo charged air induction systems.

1. State the purposes for turbo charging the engine air induction system.
2. Explain the construction and operation of a turbo charged air induction system and components including Exhaust Gas Recirculation (EGR) systems.
3. Test, inspect and service a turbocharger.
4. Explain the function, construction and testing procedures for typical aftercoolers/intercoolers.
5. Explain the function of variable displacement turbo technology and wastegate systems.

C. Lubrication Systems And Crankcase Ventilation ..... 9 Hours

Outcome: Service lubrication systems and related components.

1. State the functions and characteristics of engine oil.
2. Describe the use of oil analysis as a diagnostic tool.
3. Explain the operating principles of a typical lubrication system and related components.
4. State the purpose of crankcase ventilation systems.
5. Perform lubrication system inspection and service.
6. Diagnose and repair faults related to lubrication systems and components.

D. Cooling Systems (Liquid And Air) ..... 9 Hours

Outcome: Service liquid and air-cooling systems and related components.

1. Explain the function of the engine cooling system.
2. Explain the operation and maintenance of an air-cooling system.
3. Explain the operation of a typical liquid cooling system and its components.
4. Perform engine liquid cooling system repair and maintenance.
5. Explain the functions and design features of temperature sensors and warning devices.

SECTION THREE: ..... DIESEL FUEL INJECTION SYSTEMS ..... 40 HOURS

A. Diesel Fuel And Storage Tanks (Machine And Bulk Storage) ..... 3 Hours

Outcome: Handle and store diesel fuel using safe and efficient practices.

1. State the safety precautions, characteristics and properties of diesel fuel.
2. Explain diesel fuel storage concerns.
3. Identify construction requirements and design features of fuel storage and supply tanks.

B. Combustion Process and Starting Aids ..... 4 Hours

Outcome: Apply the theory of the combustion process to engine operation and diagnosis.

1. Explain the characteristics and factors affecting the diesel engine combustion process.
2. Explain diesel engine emission concerns.
3. Identify and state the purpose of common combustion chambers.
4. Identify types and function of common diesel engine starting aids.

C. Basic Fuel Injection System ..... 3 Hours

Outcome: Explain the operation of a basic fuel injection system.

1. List the requirements of a fuel injection system.
2. Identify the layout and components of a basic fuel injection system.
3. Explain the function of the components required in the basic diesel fuel injection system.

D. Fuel System Service ..... 5 Hours

Outcome: Service the fuel injection supply system.

1. Identify types and service procedures for common fuel filters.
2. Explain the operating principles and design features of common fuel transfer pumps.
3. Perform testing and diagnosis of a fuel transfer system.
4. Explain fuel transfer pump inspection and service procedures.

E. Port/Helix Metering Fuel Systems ..... 6 Hours

Outcome: Service port/helix metering fuel injection systems.

1. Explain the principles of port and helix fuel metering.
2. Explain two methods of timing port and helix fuel injection pumps.
3. Describe emission controls used with port and helix injection pumps.

F. Opposed Plunger Inlet Fuel Metering Systems ..... 6 Hours

Outcome: Service opposed plunger inlet metering fuel injection systems.

1. Explain the principle of inlet fuel metering for opposed plunger pump designs.
2. Explain the basic methods of timing opposed plunger pumps.
3. Describe emission controls used with opposed plunger pumps.

G. Diesel Fuel Injector Fundamentals And Service ..... 6 Hours

Outcome: Perform fuel injector testing, removal and replacement.

1. Identify hydraulic fuel injector types and construction.
2. Explain the operating principles of hydraulic fuel injection nozzles.
3. Describe fuel injector removal and replacement procedures.
4. Explain hydraulic injector testing procedures.
5. Demonstrate the procedure to isolate a faulty fuel injector on a running engine.

H. Engine Governor Fundamentals And Service ..... 6 Hours

Outcome: Explain governor operation and adjustments.

1. State the functions of engine governors.
2. Explain standard governor terminology.
3. Explain governor operation according to design characteristics and application.
4. Explain causes and symptoms of basic engine governor malfunctions.
5. Explain governor adjustment limitations and adjustments.

I. Emergency Shut-down Systems ..... 1 Hour

Outcome: Explain the operating principles of engine shutdown and warning systems.

1. Explain the operation of an engine emergency warning and shut down system that monitors oil pressure, coolant temperature, coolant level and engine over-speed.

SECTION FOUR: ..... ELECTRONICS FUEL MANAGEMENT ..... 45 HOURS

A. Electronic Fuel System Fundamentals ..... 15 Hours

Outcome: Retrieve and interpret basic diagnostic information from a typical diesel engine electronic control system.

1. Explain the operation of a computer controlled fuel injection system.
2. Explain the operation of engine sensors that measure pressure, temperature, speed, fluid level, and throttle position.
3. Explain integral warning, shutdown and fault codes systems used with electronic controls.
4. Demonstrate the use of a Personal Computer (PC) and other appropriate tools for electronic system interface.
5. Demonstrate the adjustment of electronic fuel control system parameters.

B. Electronically Controlled Fuel Injection Systems ..... 12 Hours

Outcome: Identify and explain components of electronically controlled fuel injection systems.

1. Explain the operation of an electronic unit fuel injection system.
2. Explain the operation of a HEUI fuel injection system.
3. Explain the operation of a common rail fuel injection system.
4. Explain the operation of an electronic unit pump fuel injection system.

C. Performance Analysis And Tune-up ..... 18 Hours

Outcome: Diagnose and service electronic controlled diesel fuel injection systems.

1. Explain the benefits of maintaining engine adjustments.
2. Explain engine performance testing and demonstrate diagnosis.
3. Diagnose and repair an electronic fuel control system malfunction.
4. Demonstrate removal and installation procedures of an electronic fuel pump or injector.

SECTION FIVE: ..... HEAVY DUTY CHARGING & CRANKING SYSTEMS ..... 50 HOURS

A. Charging System And Control Circuit Fundamentals ..... 12 Hours

Outcome: Explain the operation of 12 and 24 volt charging systems.

1. Explain the purpose of the charging system in relation to equipment operation.
2. Identify charging system components.
3. Describe the operational characteristics of an alternator.
4. Identify and state the function of common alternator components.
5. Describe the operation of an alternator in regards to induction, rectification and output control.
6. Identify and state the function of common alternator components.
7. Identify common regulator types and designs.
8. State the purpose of auxiliary terminals on integrally regulated alternators.
9. Explain the operation of charging system indicator circuits.

B. Charging System Testing And Service ..... 18 Hours

Outcome: Diagnose and service 12 and 24 volt charging systems.

1. Perform on-equipment charging system tests.
2. Demonstrate the procedure to bench test an alternator for output and voltage control.
3. Identify alternator defects.
4. Demonstrate charging system maintenance procedures.

C. Cranking System Fundamentals and Motor Drives ..... 3 Hours

Outcome: Explain the operation of 12 and 24 volt cranking systems.

1. Identify components of a typical cranking system.
2. Describe the principles of operation of a cranking motor.
3. Identify cranking motor construction in regards to electrical design.
4. Identify and state the function of common cranking motor components.
5. Identify and explain the operation of overrunning clutch type motor drives.
6. Explain operational limitations of a cranking motor.

D. Cranking System Control Circuits ..... 3 Hours

Outcome: Explain the operation of cranking motor control circuits.

1. Trace a starting system circuit diagram.
2. Explain the operation of a cranking motor solenoid switch.
3. Explain the operation of a magnetic switch.

E. Cranking System Testing And Service ..... 12 Hours

Outcome: Diagnose and service cranking systems.

1. Perform on-equipment cranking system tests.
2. Identify cranking motor defects by no-load test results.
3. Demonstrate the procedure to bench test and overhaul a cranking motor.
4. Identify possible cranking system failures from specific symptoms.

F. Non-Electric Cranking Systems ..... 2 Hours

Outcome: Service and maintain air and hydraulic cranking systems.

1. State the function, system requirements and troubleshooting procedures required on air cranking systems.
2. State the function, system requirements and troubleshooting procedures required on hydraulic motor cranking systems.

THIRD PERIOD TECHNICAL TRAINING
HEAVY EQUIPMENT TECHNICIAN TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

SECTION ONE: ..... HYDRAULICS II ..... 114 HOURS

A. Hydraulic Principles ..... 9 Hours

Outcome: Explain principles of hydraulics.

1. Explain the principles of hydraulic energy transfer.
2. State the characteristics of hydraulic oil.
3. Explain common hydraulic contamination control methods.

B. Hydraulic Pump Fundamentals ..... 9 Hours

Outcome: Identify common hydraulic pumps.

1. Explain common hydraulic pump configurations.
2. Explain gear pump operating principles.
3. Explain vane pump operating principles.
4. Explain piston pump operating principles.

C. Hydraulic Pump Service ..... 12 Hours

Outcome: Diagnose and repair common hydraulic pumps.

1. Explain start up procedures and precautions.
2. Service a gear pump.
3. Service a vane pump.
4. Service a piston pump.

D. Hydraulic Actuator Fundamentals ..... 6 Hours

Outcome: Identify hydraulic cylinders and motors.

1. Explain the operating principles of hydraulic cylinders.
2. Explain the operating principles of hydraulic motors.

E. Hydraulic Actuator Service ..... 9 Hours

Outcome: Service hydraulic cylinders and motors.

1. Service hydraulic cylinders.
2. Service hydraulic motors.

F. Hydraulic Valve II ..... 18 Hours

Outcome: Service hydraulic pressure, flow and directional control valves.

1. Explain the operation and service procedures of hydraulic pressure control valves.
2. Explain the operation and service procedures of hydraulic flow control valves.
3. Explain the operation and service procedures of hydraulic directional control valves.
4. Explain the operation and service procedures of directional control valve accessories.
5. Explain methods used to connect multiple directional control valves.

G. Hydraulic System Types ..... 18 Hours

Outcome: Analyze common mobile equipment hydraulic systems.

1. Interpret common mobile equipment hydraulic system schematics.
2. Explain the operation of mobile open centre hydraulic systems.
3. Explain the operation of mobile closed centre hydraulic systems.
4. Explain the operation of a mobile hydrostatic transmission hydraulic system.

H. Hydraulic System Testing And Service ..... 18 Hours

Outcome: Diagnose common mobile equipment hydraulic systems.

1. Perform visual inspection and operational tests on common hydraulic systems.
2. Perform pressure and flow testing on common hydraulic systems.
3. Determine hydraulic system faults.

I. Electro-Hydraulics ..... 15 Hours

Outcome: Analyse basic electrical and electronically controlled hydraulic systems.

1. Explain the operation principles of electrically controlled hydraulic system components.
2. Explain the operating principles of electronically controlled hydraulic system components.
3. Explain joystick and pulse width modulated control systems.
4. Diagnose electrohydraulic system faults.

SECTION TWO: STEERING AND SUSPENSION SYSTEMS & ACCESSORIES (SPECIFIC TO OFF ROAD) ..... 34 HOURS

A. Wheeled Equipment Steering Fundamentals And Service ..... 10 Hours

Outcome: Diagnose and service off-road equipment steering systems.

1. Identify common off-road steering configurations and applications.
2. Identify full time power steering system components.
3. Explain the operation of common off-road power steering systems and components.
4. Explain off-road power steering system diagnostic and service procedures.
5. Identify skid steering system components.
6. Explain the operation of a skid steering system.
7. Explain skid steering system diagnostic and service procedures.

B. Suspension System Fundamentals And Service ..... 6 Hours

Outcome: Explain off-road suspension system diagnostic and service procedures.

1. State the functions and applications of common off-road suspension systems.
2. Explain the operation of a motor scraper cushion hitch system.
3. Explain cushion hitch diagnostic and service procedures.
4. Explain the operation of common haul truck suspension systems.
5. Explain common haul truck suspension system diagnostic and repair procedures.

C. Off-road Equipment Accessories And Attachments ..... 6 Hours

Outcome: Service and maintain accessories and attachments used with off-road equipment.

1. Explain the functions and operating principles of operator protective structures.
2. Explain operator protective structures in regards to service and maintenance precautions.
3. Identify and explain the purpose of automatic fire suppression systems used on off-road equipment.
4. Identify and explain the functions of common ground engaging tools and tool mounting components.
5. Explain the procedures required to service common ground engaging tools.
6. Explain the operating principles and service procedures required for common types of winches.

D. Off-road Electrical Circuit Fundamentals ..... 6 Hours

Outcome: Explain the operation of typical off-road equipment electrical and warning circuits.

1. Explain the operation of off-road equipment lighting circuits.
2. Explain the operation of off-road equipment accessory circuits.
3. Explain the operation of audible and visual warning devices.

E. Off-road Electrical Circuit Service ..... 6 Hours

Outcome: Diagnose and repair off-road equipment electrical circuits.

1. Perform basic test procedures on off-road equipment lighting circuits.
2. Perform basic test procedures on off-road equipment accessory circuits.
3. Explain precautions when servicing electronic dash systems.

SECTION THREE: .....POWER TRAIN (SPECIFIC TO OFF ROAD).....92 HOURS

A. Gearing Principles ..... 3 Hours

Outcome: Explain basic gearing principles.

1. Define gear terminology.
2. Explain gear relationships with regards to ratios and input/output direction.
3. Identify common gear types and applications.

B. Torque Converter Fundamentals And Service ..... 9 Hours

Outcome: Diagnose and repair common off-road equipment torque converters.

1. Describe the function and concepts of fluid converters.
2. Describe the components and operation of torque converters.
3. Explain the operation of a torque divider.
4. Explain basic torque converter mounting, diagnostic and repair procedures.

C. Powershift And Automatic Transmission Mechanical/Electronic Components..... 14 Hours

Outcome: Explain the operation of powershift and automatic transmissions mechanical components.

1. Compare functions and applications of powershift and automatic transmissions.
2. Explain gearing principles of single and multiple planetary gear seats.
3. Explain the operation of a typical planetary type transmission.
4. Explain the operation of typical countershaft type powershift/automatic transmissions.

D. Powershift and Automatic Transmission Control and Shifting ..... 10 Hours

Outcome: Explain the operation of powershift and automatic transmission shift control mechanisms.

1. Explain the operation of hydraulic shift control systems for powershift transmissions.
2. Explain the operation of hydraulic shift control systems for automatic transmissions.
3. Explain the operation of electronic shift control systems for automatic transmissions.

E. Hydraulic Retarder Fundamentals ..... 3 Hours

Outcome: Explain the operating principles for off-road equipment hydraulic retarders.

1. Identify the components of a typical off-road equipment hydraulic retarder.
2. Explain the operation of a typical off-road equipment hydraulic retarder.

F. Powershift And Automatic Transmission Testing And Service ..... 10 Hours

Outcome: Diagnose and service powershift and automatic transmissions.

1. Perform powershift and automatic transmission visual inspections and operational tests.
2. Perform powershift and automatic transmission hydraulic shift control system testing.
3. Perform powershift and automatic transmission electronic shift control system testing.
4. Explain the procedures to remove and reinstall a powershift and automatic transmission.

G. Tracked Equipment Steering Fundamentals And Service ..... 11 Hours

Outcome: Explain tracked equipment steering system diagnostic and service procedures.

1. Explain the operation of a steering clutch and brake crawler tractor steering system.
2. Explain the diagnostic and service procedures for a steering clutch and brake crawler tractor steering system.
3. Explain the operation of a hydrostatic crawler tractor steering system.
4. Explain diagnostic and service procedures for a hydrostatic crawler tractor steering system.
5. Explain the operation of a differential type crawler tractor steering system.
6. Explain the diagnostic and service procedures for a differential type crawler tractor steering system.

H. Undercarriage Systems Fundamentals And Service ..... 11 Hours

Outcome: Explain diagnostic and service procedures for tracked equipment undercarriage and related components.

1. Describe the functions, applications and configurations of undercarriage systems.
2. Explain the functions and operation of the components of typical undercarriage systems.
3. Perform undercarriage inspection and adjustment procedures.
4. Explain the procedures required for safely removing and replacing undercarriage components.
5. Explain procedures for remanufacturing undercarriage components.

I. Final Drive Fundamentals And Service (off road) ..... 6 Hours

Outcome: Explain diagnostic and service procedures for off-road equipment final drive systems.

1. Describe the functions, applications, and configurations of drive systems.
2. Explain the operation of wheeled equipment final drive systems.
3. Explain the operation of tracked equipment final drive system.

4. Explain maintenance and service procedures for final drive systems.

J. Drive Axle and Differential Fundamentals and Service (off road)..... 12 Hours

Outcome: Repair drive axle and differential assemblies.

1. State the functions of single reduction drive axle assemblies.
2. Identify single reduction drive axle components.
3. Explain the operating principles of a single reduction drive axle and differential assembly.
4. Identify common types of differential units used in the trade
5. Explain the lubrication of a single reduction drive axle.
6. Diagnose a drive axle and differential assembly for operational faults.
7. Explain drive axle and differential assembly removal and replacement procedures.
8. Overhaul a typical drive axle and differential assembly to manufacturer's specifications.

K. Clutch Fundamentals And Service ..... 3 Hours

Outcome: Service and diagnose common clutch types.

1. Explain the operation and maintenance of over-centre clutches.
2. Explain the operation principles of special application clutches: overrunning, dog, cone and bevel, electromagnetic.

FOURTH PERIOD TECHNICAL TRAINING
HEAVY EQUIPMENT TECHNICIAN TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

SECTION ONE: .....POWER TRAIN (SPECIFIC TO TRUCK AND TRANSPORT).....124 HOURS

A. Clutch Fundamentals And Service ..... 9 Hours

Outcome: Service and diagnose common clutch types.

1. Explain the function and operating principles of spring loaded clutch systems.
2. State the function of spring-loaded clutch components.
3. Diagnose spring-loaded clutch operating faults.
4. Perform service procedures for spring-loaded clutches.
5. Explain the function and operating principles of auto adjust clutches.
6. Explain the function and operating principles of centrifugally engaged clutch systems.

B. Drive Line Fundamentals And Service ..... 12 Hours

Outcome: Diagnose and service drivelines and universal joints.

1. Explain the function and operating principles of common driveline assemblies.
2. Explain the construction and design features of common driveline components.
3. Diagnose and service universal joints.
4. Explain and check driveline phasing, angles and angle limitations.
5. Explain the procedure to rectify driveline vibrations.

C. Gearing Principles ..... 3 Hours

Outcome: Explain basic gearing principles.

1. Define gear terminology.
2. Explain gear relationships with regards to ratios and input/output direction.
3. Identify common gear types and applications.

D. Transmission Fundamentals ..... 12 Hours

Outcome: Explain the principles of operation and design features of synchromesh and multiple countershaft mechanical transmissions.

1. Explain vehicle power train requirements in relation to engine performance characteristics and vehicle applications.
2. Explain the operation of a synchromesh transmission.
3. Explain the operating principles of multiple countershaft transmission main section mechanical components.
4. Explain the operation of multiple countershaft transmission auxiliary section mechanical components.
5. Explain the lubrication of transmissions.

E. Transmission Shifting ..... 12 Hours

Outcome: Explain multiple countershaft mechanical and electronic transmission shift controls.

1. Explain the operation of the components of a mechanical air shift system.
2. Explain mechanical transmission air shift system operation.
3. Explain the operating principles of an electronic automated top gear shifting system.
4. Explain the basic operation of mechanical transmission electronic shift controls.

F. Transmission Service ..... 30 Hours

Outcome: Repair synchromesh and multiple countershaft mechanical transmissions.

1. Explain how to service and maintain constant mesh transmissions.
2. Diagnose operational faults associated with typical constant mesh transmissions.
3. Overhaul a synchromesh transmission to manufacturer's specifications.
4. Overhaul a multiple countershaft transmission to manufacturer's specifications.
5. Perform failure analysis on the components of a typical constant mesh transmission.
6. Explain transmission installation procedures.
7. Perform air shift system diagnosis and troubleshooting.

G. Transfer Case and Auxiliary Drives ..... 4 Hours

Outcome: Explain the operating principles and repair procedures of transfer cases and auxiliary drive units.

1. Explain how to service and maintain constant mesh transmissions.
2. Explain the diagnosis and service of a typical transfer case.
3. Explain the principles of operation and design features of typical PTO (power take off) units.
4. Explain PTO installation procedures and precautions.
5. Explain PTO diagnosis and service procedures.

H. Drive Axle Assembly Fundamentals (on road) ..... 12 Hours

Outcome: Explain the functions and operating principles of drive axle assemblies.

1. Explain drive axle requirements in relation to vehicle applications.
2. State the functions of a drive axle assembly.
3. Identify drive axle configurations and components.
4. Explain the operating principles of a differential assembly.
5. Explain the operating principles of an inter-axle differential assembly.
6. Explain common axle shaft configurations.
7. Explain the lubrication of a drive axle.
8. Explain the operating principles of wheel lock assemblies.

I. Drive Axle Assembly Service (on road) ..... 30 Hours

Outcome: Repair drive axle assemblies.

1. Diagnose a drive axle assembly for operational faults.
2. Explain differential carrier assembly removal and installation procedures.
3. Overhaul a typical differential carrier assembly to manufacturer's specifications.
4. Overhaul a typical inter-axle differential assembly.

SECTION TWO: ..... STEERING SYSTEMS ..... 27 HOURS

A. Steering Fundamentals ..... 8 Hours

Outcome: Diagnose truck steering systems.

1. Explain the operating principles of steering systems.
2. Explain the construction and design features of steering components.
3. Identify the components of a truck power steering system.
4. Explain the operation of power steering system components.

B. Steering Service ..... 10 Hours

Outcome: Diagnose and service truck steering systems.

1. Explain steering component service procedures.
2. Diagnose power steering system faults.
3. Explain hydraulic system testing and adjustment procedures.
4. Describe the procedures required to remove and replace power steering components.
5. Describe the procedures for adjusting an integral power steering gearbox.

6. Service a power steering gear.

C. Steering Angles And Alignment ..... 9 Hours

Outcome: Identify steering angles and their effects on vehicle handling.

1. Explain steering system geometric principles and their effects on vehicle handling and tire wear.
2. List pre-alignment inspection procedures.
3. Describe common methods of adjusting wheel alignment angles to achieve manufacturer's guidelines.

SECTION THREE: ..... AIR CONDITIONING ..... 36 HOURS

A. Air Conditioning Fundamentals ..... 8 Hours

Outcome: Explain the operating principles of basic air conditioning systems.

1. Explain the thermodynamic principles related to air conditioning.
2. Explain the properties and handling precautions of refrigerants and refrigerant oils.
3. Identify the basic components of an air conditioning system.
4. Explain the operation of a clutch cycling air conditioning system using an expansion valve or an orifice tube.

B. HVAC Control Systems (Heating, Ventilation And A/C) ..... 12 Hours

Outcome: Explain the operating principles of HVAC (Heating, Ventilation and Air Conditioning) control systems.

1. Identify the components of an air conditioning control system.
2. Explain the operation of air conditioning control systems.
3. Identify the components of an automatic temperature control system.
4. Identify the components of an air distribution system.
5. Explain the operation of an air distribution system.
6. Explain the operation of a typical sleeper temperature control system.
7. Explain the procedure to test HVAC control system operation.

C. Air Conditioning Testing And Service ..... 16 Hours

Outcome: Diagnose and service air conditioning systems.

1. State the safety precautions required when servicing air conditioning systems.
2. Identify air conditioning service tools.
3. Perform air conditioning system diagnosis.
4. Perform air conditioning service within legislated guidelines.
5. Explain replacement procedures for defective air conditioning components.

SECTION FOUR: ..... ANTI LOCK BRAKE SYSTEMS (AIR AND HYDRAULIC BRAKES) ..... 26 HOURS

A. Air Anti Lock Brake Systems ..... 6 Hours

Outcome: Explain the operation of antilock braking system (ABS) and automatic traction control (ATC) systems.

1. Review the operation of an antilock brake system (ABS).
2. Identify and explain the operation of the individual ABS components.
3. Explain the operation of the ABS.
4. Explain the interface between the tractor and the trailer.
5. Identify and explain the operation of the individual automatic traction control (ATC) components
6. Explain the operation of the ATC system.
7. List ABS and ATC service precautions.

B. Air Antilock Brake System Diagnosis ..... 10 Hours

Outcome: Diagnose and service air antilock braking systems (ABS).

1. Explain a logical procedure to troubleshoot an air ABS.
2. Identify service tools for ABS diagnosis.
3. Describe methods used to test failed ABS components.
4. Diagnose and repair ABS faults.

C. Hydraulic Anti Lock Brake Systems ..... 10 Hours

Outcome: Explain the operation of typical hydraulic antilock braking systems (ABS).

1. Identify the components of a hydraulic ABS.
2. Explain hydraulic system operation.
3. Explain electronic system operation.
4. Describe hydraulic ABS service and diagnostic procedures.
5. Demonstrate the procedure to bleed a hydraulic ABS.

SECTION FIVE: ..... VEHICLE ELECTRICAL DIAGNOSIS & FAILURE ANALYSIS ..... 27 HOURS

A. Truck Electrical Circuit Fundamentals ..... 6 Hours

Outcome: Explain the operation of typical truck electrical and warning circuits.

1. Explain the operation of truck lighting circuits.
2. Explain the operation of truck accessory circuits.
3. Explain the operation of audible and visual warning devices.

B. Truck Electrical Circuit Service ..... 7 Hours

Outcome: Diagnose and repair truck electrical circuits.

1. Perform basic test procedures on truck lighting circuits.
2. Perform basic test procedures on truck accessory circuits.
3. Explain precautions when servicing electronic dash systems.

C. Failure and Fluid Analysis ..... 8 Hours

Outcome: Explain predictive maintenance procedures utilizing failure and fluid analysis.

1. Explain fluid (oil and coolant) analysis.
2. Explain basic failure analysis.

D. Orientation to Vehicle Inspection ..... 6 Hours

Outcome: Explain truck inspection according to Commercial Vehicle Inspection (CVI) regulations.

1. Outline provincial truck inspection regulations.
2. Identify conditions caused by damage, wear or corrosion that would make a truck unsafe or inoperable.
3. Identify conditions that would require further inspection.

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